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CHEMICAL INJURY TO WATERMELONS IN TRANSIT

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INTRODUCTION

For a number of years railroad companies and shippers have frequently reported injury to watermelons in transit which they attributed to contact with chemicals, including fertilizer materials, left on the walls and floors of ventilator box freight cars. In many cases it has been evident from a description of the damage that the so-called "chemical injury" was no more than decay due to one or more of the several fungi which commonly cause watermelon rots. Inquiries for exact information on chemical injury are received every year from the trade.

STATIONARY TESTS

To obtain preliminary data on what chemicals carried in box freight cars can cause injury to watermelons and under what conditions, as well as data on the appearance of the injury itself, a series of stationary tests was conducted at the Arlington Experiment Farm, near Rosslyn, Va., in the fall of 1925.

In planning these tests, consideration was given to the facts that under actual shipping conditions the watermelons on the bottom layer are subjected to the weight of three or four layers above, that the bedding used may be insufficient or irregularly distributed in the car, and that under some conditions it may be moist. Although it is not considered good practice to load watermelons on anything but dry bedding, it occasionally happens that because of continued rains during the shipping season damp materials are sometimes carelessly used. Moreover, it frequently happens that rain driven through the screen of the side doors while the cars are in motion or standing in the yards wets a considerable portion of the load, especially near the doorways. It was expected that moisture at the bottom of the load

would increase the danger of injury to the melons in the lower layer if certain chemical residues were present on the floor of the car.

The following methods were used in setting up the experiments. In the first test 35 Irish Gray and 35 Excel melons were placed directly on a half-inch layer of the chemicals, both wet and dry. An abundance of the chemicals was used to insure a thorough test. A sack of gravel equal to the total weight of three average-sized melons, namely, about 75 pounds, was placed on each of several melons to simulate the conditions of the usual pack. Notes on the injury caused and photographs of injured melons were taken on the fifth day and again on the tenth.

Eight of the chemicals included in the first test are commonly shipped in freight cars throughout the watermelon-producing territory, either singly or in various fertilizer combinations. Common salt, which may be present on the floors of cars that have contained hides, meats, or other products necessitating a preservative packing, was also used.

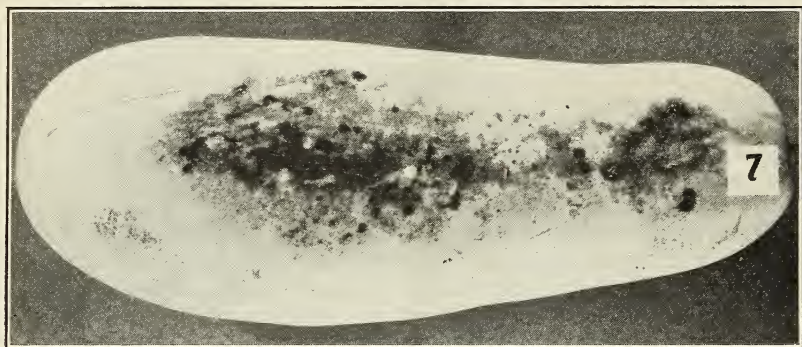


FIGURE 1.—Injury to Irish Gray melon in stationary test from direct contact with wet nitrate of soda under 75 pounds pressure for 5 days

On the fifth day, when the first examination was made, it was found that marked injury had resulted to those watermelons placed in direct contact with several moistened chemicals under pressure equal to the weight of three layers of melons, the usual condition in shipment. Among the materials causing considerable injury under these conditions were superphosphate (acid phosphate), muriate of potash, nitrate of soda (fig. 1), common salt, sulphate of ammonia, and sulphate of potash. Neither hydrated nor air-slaked lime was injurious, though these materials have frequently been blamed for such damage. When the experiment was terminated at the end of 10 days, the injury that was present on the first examination was found to be accentuated.

When the chemicals were not moistened there was some injury at the end of five days from sulphate of ammonia, nitrate of soda, and common salt. This was greatest where pressure was applied and was more pronounced at the end of the experiment. (Fig 2.)

In practically all tests the injury to the light-colored Irish Gray melons was much more noticeable and severe than that on the dark-green Excel melons. Sulphate of ammonia, both wet and dry, was

injurious in every test, with and without pressure. In cases of slight injury it caused a water-soaked appearance on the green melons, with browning and sinking of the injured areas. On the Irish Gray melons a tan to brown discoloration was very conspicuous, combined with depression of the injured tissues in the more severe cases. Browning, withering, softening, and flattening of the melons were characteristic symptoms of the most severe injury.

Next to sulphate of ammonia, nitrate of soda caused the most conspicuous and general damage, the character of the injury resembling that due to sulphate of ammonia. These chemicals, together with common salt, seem to produce injury partly by extraction of the moisture from the melon by osmosis, resulting in softening, withering, and shrinking of the rind where it comes in contact with the chemicals, as well as a marked flattening due to the weight above it. At the same time the chemicals penetrate the rind and,

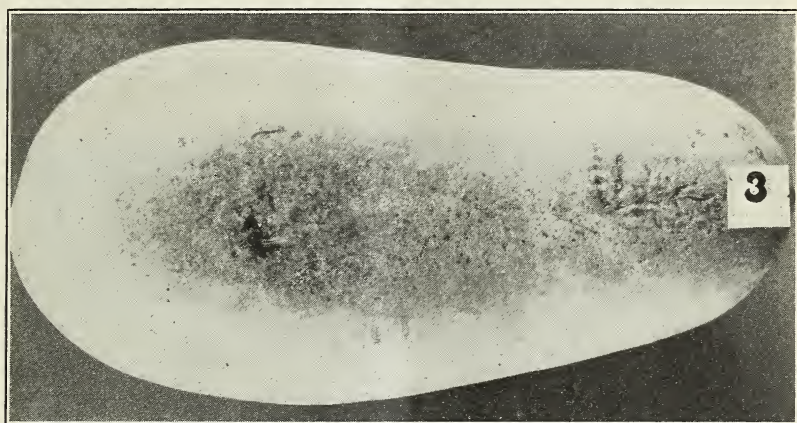


FIGURE 2.—Injury to Irish Gray melon in stationary test from direct contact with dry common salt under 75 pounds pressure for 10 days

in the worst cases, the flesh of the melons. Table 1 presents notes on the injury produced by the different chemicals in the stationary tests at the end of the 5-day period.

In a repetition of the experiment described above, straw was used in some cases and building paper in others to protect the melons from the chemicals, both the straw and the paper being moistened. A 75-pound sack of gravel was placed on each melon. Under these conditions, where the melons were protected by straw, injury was produced by some of the same chemicals as in the previous experiment, but the damage was less severe. Where building paper was used, considerable injury also occurred in several instances, which suggests the possibility that in the occasional car, where the walls are here and there plastered with chemical residues, the usual paper lining of the walls may not give complete protection.

TABLE 1.—*Injury to watermelons in stationary test from direct contact with several wet and dry chemicals, with and without pressure, for five days*

Conditions	Variety	Potassium sulphate	Superphosphate	Ammonium sulphate	Potassium muriate	Air-slaked lime	Hydrated lime	Common salt	Sodium nitrate
Dry	Without pressure	Excel		Small depressed area.	No injury	No injury	No injury	No injury	No injury.
		Irish Gray	do	Very slight water-soaked appearance.	Very slight light-brown spotting.	do	do	Small brown spots where in contact with salt.	Small amount of water-soaking in small spots.
	With pressure	Excel	do	Dark-green water-soaked appearance (little apparent injury).	No injury	Very small amount of injury.	do	Small brown spots, small brown spots, slight softening, no discoloration.	
		Irish Gray	do	Very slight injury.	Slight spotting, light brown.	No apparent injury.	do	Many small brown spots over large area, soft, depressed.	Marked injury; withered, sunken, and softened.
Wet	Without pressure	Excel	4 by 8 inch brown sunken area.	Slight spotting (no real injury).	Slight brown spotting, but not depressed.	No injury	do	No injury	Irregular areas $\frac{1}{2}$ to $\frac{1}{4}$ inches in diameter depressed $\frac{1}{4}$ inch and softened.
		Irish Gray	6 by 8 inch slightly depressed, gray-white area surrounded by rusty brown spots.	Greenish, water-soaked appearance and slightly softened.	Marked injury	do	do	Light-brown depressed spots with a abrupt margins.	Considerable injury; soft, shrunk, brown, and depressed.
	With pressure	Excel	3 by 7 inch brown-spotted sunken area.	Slight water-soaked appearance (no serious injury).	No injury apparent.	do	do	No injury	Shriveling and softening in long area with some sunken spots; softening quite pronounced.
		Irish Gray	2 by 6 inch rusty-brown depressed area.	4 by 8 inch area, softened, brown, shrunken.	2 by 3 inch area, softened, sunken $\frac{1}{4}$ inch, light brown.	do	do	More severe injury than without pressure, and with some softening.	More injury than without pressure, sharper margins to depressed areas. (See fig. 1.)

SHIPPING TESTS

One of the important factors lacking in these stationary tests was that of the motion of the freight cars, the effect of which could be obtained only by carrying out actual shipping tests. It was therefore thought desirable to conduct such tests with the chemicals in question under the usual transit conditions, so that facts directly applicable to commercial shipments might be determined. These test shipments were conducted during the season of 1927 from Okahumka, Fla., to New York City, a 5-day haul, and in 1928 from Quitman, Ga., to Washington, D. C., a 4-day haul. All the cars were packed under the supervision of the junior writer, and photographs and notes on the conditions of the melons on arrival at destination were made by the senior writer.

Common salt, nitrate of soda, superphosphate, hydrated lime, a mixed fertilizer,¹ a watermelon fertilizer,² sulphate of ammonia, sulphate of potash, ground limestone, and muriate of potash were each tested on eight melons, except that in the last two treatments six melons each were used. In addition to these tests involving loose chemicals, two others were included in which Douglas fir boards

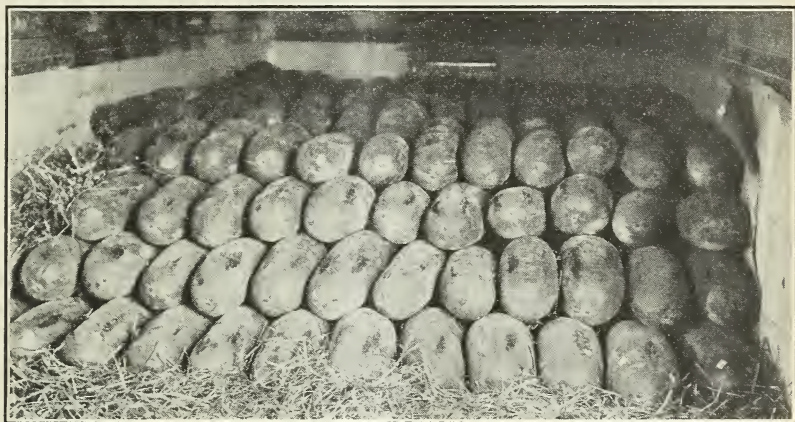


FIGURE 3.—Test melons labeled in bottom layer of shipping test—standard pack

which had been soaked for 7 to 10 days in concentrated solutions of salt and of nitrate of soda were nailed down so as to form a false floor in one end of the car. This chemically soaked flooring gave space in two corners of the car for two lots of six melons each. In carrying out the tests with loose chemicals the areas where they were laid out were surrounded by strips of lath nailed to the floor to prevent them from shifting. The different materials were separated by one to three tiers of melons not included in the test. The straw or excelsior bedding was then placed over them. Labels with large numbers were pasted on the melons on the bottom layer in

¹ Made up as follows (pounds per ton): Nitrate of soda, 135; Peruvian guano, 200; sulphate of ammonia, 80; steamed bone meal, 665; superphosphate, 720; goat manure, 100.

² Made up as follows (pounds per ton): Peruvian guano, 200; goat manure, 1,000; Ammo Po, 115; sulphate of potash, 115; superphosphate, 570.

each test (fig. 3), and above these, three layers of melons were packed, giving the usual 4-layer load.

TESTS IN SEASON OF 1927

The car shipped in 1927 from Florida to New York was loaded as heretofore described, using moist scant bedding (less than two bales of excelsior), which was employed because the preliminary tests had shown that but slight injury resulted from dry chemicals even when in direct contact with the melons. When this carload was examined at Kearny Yards, N. J., after a 5-day trip, it was found that much damage had been caused by some of the chemicals, not only to those melons actually in the tests, but to some in the bottom layers of adjacent tiers as well. In fact, the injury was much more

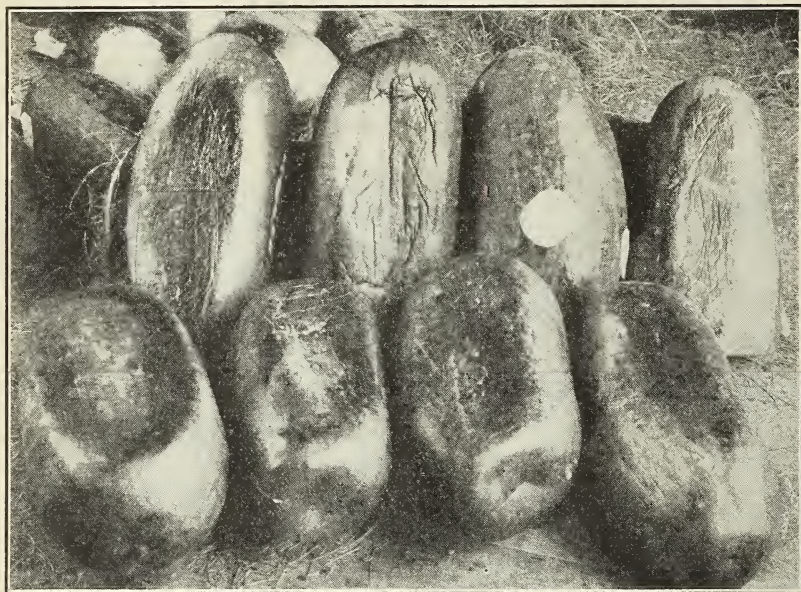


FIGURE 4.—Water-soaking, softening, wrinkling, and flattening of Watson melons in shipping test with nitrate of soda covered with scant, moist bedding, season of 1927

general and severe than the preliminary tests had indicated would occur. This injury consisted in some cases of extreme water-soaking, browning, softening, withering, and flattening of the lower portions of the melons, which was most pronounced in those in contact with sulphate of ammonia, muriate of potash, nitrate of soda (figs. 4 and 5), common salt (fig. 5), the mixed fertilizer, and the watermelon fertilizer. In the case of superphosphate the injury was somewhat different, less extensive, more sharply outlined and corrosive in appearance, not water-soaked or wrinkled, but instead the surface was leathery and whitened or tan colored. (Fig. 6.) This damage was accompanied by breakage of some of the melons which were most severely injured by the chemicals and also by some shifting of the load following the breakage in the lower layers. The broken melons

released additional moisture, which helped to increase the injurious effect of the chemicals.

TESTS IN SEASON OF 1928

The combination of scant bedding, moisture, and the motion of the car in transit subjected the melons to a more severe test than would



FIGURE 5.—Halves of Watson melons, showing rinds softened and shrunken and melons flattened by shipment over common salt (left) and nitrate of soda (right) with scant, moist bedding

normally occur in the usual commercial pack. Hence it was thought advisable to repeat the tests under more nearly commercial conditions, with dry bedding, both scant bedding (less than two 75-pound bales of straw per car) and full bedding (2 to 3 bales per car), as



FIGURE 6.—Injury to Watson melon from superphosphate covered with scant, moist bedding in shipping test of 1927

well as with abundant damp bedding, which, although not recommended, is nevertheless sometimes used. This was done in 1928, when three cars were shipped from Quitman, Ga., to Washington, D. C. These were loaded in the same way, and the same chemicals were used as in the shipments in 1927.

The watermelons in the car in which dry full bedding (3 bales of straw to the car) was used, showed no injury of any importance. Those in the car shipped with moist full bedding likewise showed no appreciable injury.

In the third car of the shipments in 1928, which was loaded with dry but scant bedding (less than 2 bales of straw per car), considerable injury resulted from the following chemicals: Common salt (fig. 7), nitrate of soda, sulphate of ammonia, muriate of potash (fig. 8), and sulphate of potash. All caused more or less dark water-soaking, softening, wrinkling, and flattening of the melons, rendering many of them unmarketable. Slight injury was also caused by superphosphate and by the mixed and watermelon fertilizers. This consisted largely of a greenish water-soaked appearance of the parts in contact with the chemicals. The injury was similar to that obtained in the 1927 shipment with moist scant bedding, but it was not as general or severe. In none of the shipments in 1928 were melons

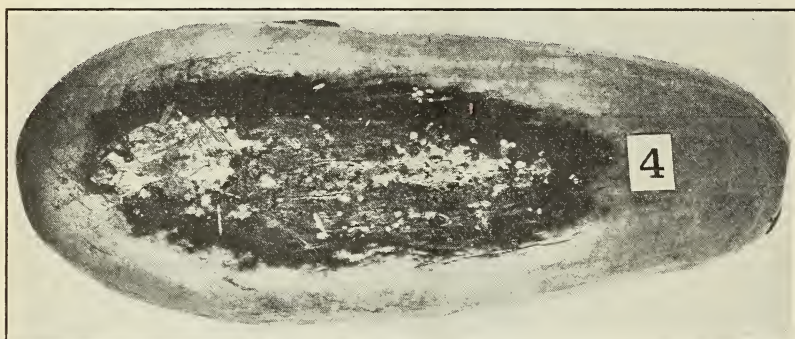


FIGURE 7.—Watson melon injured by shipment over salt, with scant, dry bedding, tests of 1928

seriously injured when loaded over boards soaked in solutions of salt or nitrate of soda.

SUMMARY

This circular presents the results of stationary experiments and actual shipping tests with watermelons to determine whether certain chemicals including fertilizer materials left as residues on the walls and floors of box freight cars can cause injury to melons, and if so, the character of such injury and the conditions under which it may occur. The results obtained should be of interest to watermelon growers, shippers, receivers, and transportation companies.

Of the 10 chemicals used, the following are capable of producing injury under certain conditions: Common salt, nitrate of soda, sulphate of ammonia, sulphate of potash, muriate of potash, superphosphate, a mixed fertilizer, and a watermelon fertilizer.

Two general types of injury were noted: (1) A sunken, corroded, leathery appearance, produced by superphosphate; (2) a browning, water-soaking, withering, and softening of the melons, which was caused by each of several chemicals.

Hydrated lime, air-slaked lime, and ground limestone (unburned) did not cause appreciable injury.

The most pronounced injury in the shipping tests resulted when moist, scant bedding was used. Considerable damage also resulted from some of these same chemicals when scant, dry bedding was used, as might easily be the case commercially if, in cars containing



FIGURE 8.—Watson melons damaged by shipment over muriate of potash, with scant, dry bedding, tests of 1928

chemical residues, less than 2 bales of straw per car were used or if more complete bedding were irregularly distributed.

From the results obtained, it seems evident that thorough cleaning of the cars before loading, combined with the use of paper side-wall protection and ample dry bedding (the equivalent of about three 75-pound bales of straw to the car), will almost entirely prevent chemical injury to watermelons in transit.

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July 12, 1929

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